Journal of Global Biosciences
ISSN 2320-1355
Volume 5, Number 9, 2016, pp. 4556-4567
Website: www.mutagens.co.in
E-mail: submit@mutagens.co.in
researchsubmission@hotmail.com

Research Paper

STUDY OF WATER QUALITY PARAMETERS OF CAUVERY RIVER WATER IN ERODE REGION

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Abstract

The present study is focused on the determination of physico-chemical parameters, such as temperature, pH, EC, hardness, chlorides, alkalinity, DO, BOD_5,COD, phosphate and sulphate of water samples from different sampling points. Increase of pollution concentration indicate an increase in the pollution load due to domestic sewage and industrial effluents and anthropogenic activities and discharge of wastes to the discharge into river at Erode district. In the present study water samples were collected from the whole city was divided in four regions for well-organized sampling and interpretation. The results revealed that the average pH value was analyzed as 7.86, Electrical Conductivity was 920 $\mu S/cm^{-1}$, parameters include Total Solids 1580 mg/l, Total Dissolved Solids 1004 mg/l, total suspended solids was 690 mg/l, total hardness was 340 mg/l, chloride was 380 mg/l, dissolved oxygen was 5.59 mg/l, BOD_5 was 38 mg/l, COD was 304 mg/l, phosphate was 6.0 mg/l and sulphate was 60 mg/l of the river water sample. Therefore the study revealed that how the Cauvery river water is contaminated by effluents from small scale industries and dumping of wastages from markets and domestic use wastages.So waterquality management is urgently required to achieve the water quality standards determined by WHO.Correlation coefficient showed highly significant positive and negative relationship.

Key words: Industrial effluent, Total dissolved solids, physico-chemical, Domestic waste.

INTRODUCTION

An Erode District lies between 10.36' and 11.58' degrees of northern latitude and between 76.49' and 77.58' degrees of the Eastern longitude and 171.91 m above mean

sea level. It has an area of 8,162 square kilometres accounting for 6.3% of the total area of the state. Agriculture is the most important income source of the district. Total cultivated area is 37.89% of the total area. Water is an important resources in the all living organisms, it is 70% of the earth surface occupies by water used for human development like drinking, irrigation and culturing of fishes. The Cauvery is one of the largest river of the Indian subcontinent. It originates from the Brahmagiri range of the Western Ghats, and flows for about 800 km west to east before corrupting at the Bay of Bengal (Umamaheshwari, 2016). Cauvery River is the main source of drinking water, irrigation and industry in Erode district. To study epidemiological of river Cauvery at Erode is extensive due to the large tannery, textile and dyeing activities for which the city is familiar. Disposal of Sewage, Industrial wastes and other human activities effects of Cauvery river were highly polluted **(**Venkatachalapathy and Karthikeyan, 2013).

The quality of potable water depends on water sources like river, well and lake etc. The condition of drinking water may be polluted with pathogen, toxic metal, chemical compounds such as pesticides, herbicides and other industrial waste becomes waterborne outbreaks **(**Begum, and Harikrishna, 2008**)**. The quality of the shallow aquifers in and around the textile, bleaching and dyeing units, which use a wide variety of chemicals and dyes at Erode, Bhavani and Chennimalai and their environs are highly polluted due to the indiscriminate discharge of untreated effluents in the nearby low lying lands and rivers and found unsuitable for all purposes. The river bank and they are using water from the river and discharging the treated and untreated effluents. The people living in the downstream are using the water for their irrigation, drinking and other domestic activities. As per the survey conducted, about 150 dyeing units and 20 tanneries are in operation in catchment area and expected to discharge the trade effluent (both treated and untreated) either directly or indirectly through drain (Sivakumar *et al*., 2010).

The present study was aimed at analyzing some important characteristics of wastewater considered herein for the Cauvery river by Erode City area of Tamilnadu. Physic-chemical parameters such as pH, temperature, EC, TS,TDS ,TSS, chloride content, Hardness, alkalinity, DO, BOD_5, COD, SO_4, PO_4 etc were carried out.

METHODOLOGY

Site description and sample collection

Surface water samples were collected from river Cauvery (four polluted sites), R. N. Pudur (11^0 25.0124' N 770 40.916' E), B.P. Agraharam (11^0 22.9942' N 770 42.7541' E), Vairapalayam (11^0 22.3000' N 770 43.4805' E) and Pallipalayam (11^0 20.9635' N 770 45.2311' E) located at city of Erode. All four locations comprises of many small tanning and dyeing units which drains the majority of their effluents into the river without proper effluent treatment. Besides, the water resource was used for domestic and fishing purposes. Water samples from all the sites were collected in sterile glass bottles, brought to the laboratory, processed within 1-3 hrs, and stored at −20°C for further analysis.

Physicochemical analysis

Following physico-chemical properties were studied. Total dissolved solid (TDS) of water and fixed residue was measured by evaporation method. Dissolved oxygen (DO) and biochemical oxygen demand (BOD) of water was measured by sodium thiosulphate titration method. Chemical oxygen demand (COD) was measured by titration of potassium dichromate and sodium thiosulphate (APHA. 2005).

RESULTS AND DISCUSSION

The water samples were analyzed for physicochemical characteristics. The physicochemical parameters were analyzed namely Temperature, pH, EC, TS, TDS, TSS, Total Hardness, DO, COD, BOD_5, Chloride, PO_4 and SO_4 (Table 1) whereas the correlation coefficients (r) among the average ofeach parameters are presented in Table2.

Temperature: Temperature of water may not be as important in pure water because of the wide range of temperature tolerance in aquatic life, but in polluted water, temperature can have profound effects on dissolved oxygen (DO) and biological oxygen demand (BOD).The fluctuation in river water temperature usually depends on the season, geographic location, sampling time and temperature of effluents entering the stream (Ahipathy, 2006).The water temperature was found to be maximum 27.5º C East. The temperature of west and north was recorded (Figure 1) as 26º C. The lowest water temperatures were observed in south site 25ºC. The variation is mainly related with the temperature of atmospheric and weather condition (Adebowale *et al*., 2008).

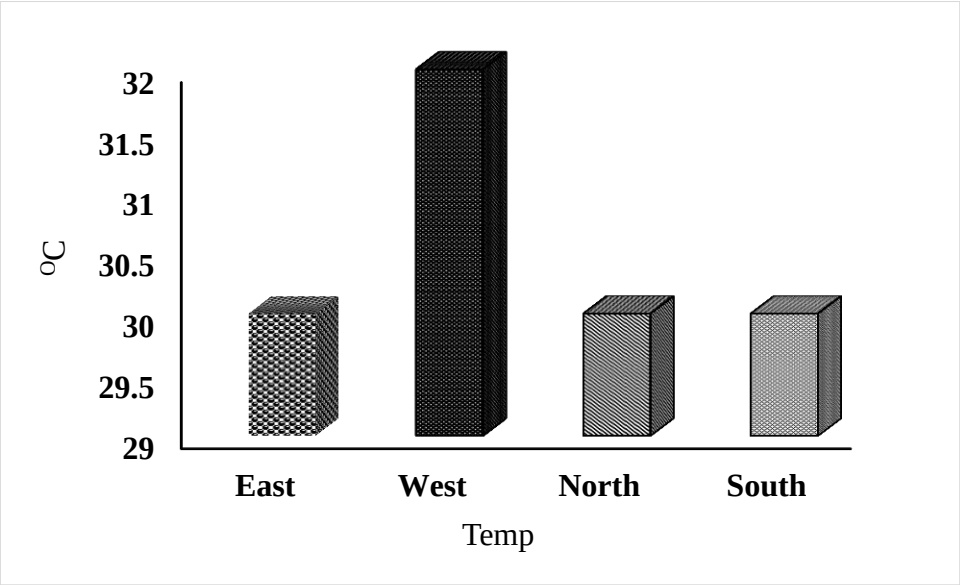

Figure 1 Variation of the temperature of water samples at different locations

pH: The pH values of the samples ranged from 5.0-9.0, where most of the water samples different location tested in the study were found to be in the permissible range of pH value recommended by several health and pollution control organizations e.g. WHO, CPCB, BIS i.e. 6.5-8.5. The pH of river water was showing alkaline character throughout the study period at all four sites. The pH value (Figure 2) ranged between 7.63 to 7.86. At south pH value noticed 7.63, north7.63, east 7.85 and west 7.86, respectively. Ahmed and Rahman (2000) reported that in most raw water sources pH lies in the range of 6.5-8.5.

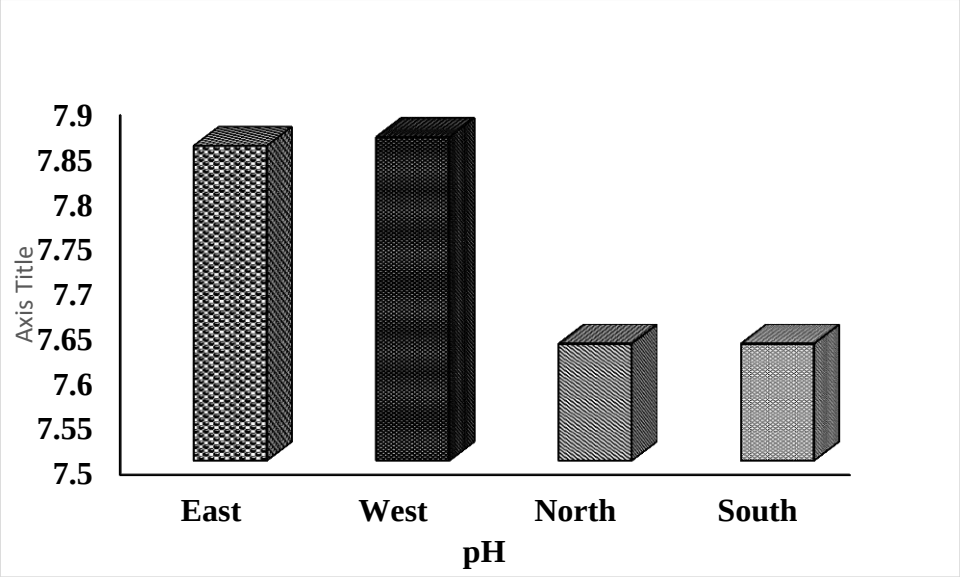

Figure 2 Variation of the pH of water samples at different locations

Electrical conductivity: Electrical conductivity usually used for indicating the total concentration of ionized constituents of water (Huq andAlam, 2005). Electric conductivity is varying much having low at north 564µS/cm^{-1}. In west range was recorded as 920 µS/cm^{-1}. But slightly vary about south 653 and east 692 µS/cm^{-1}.

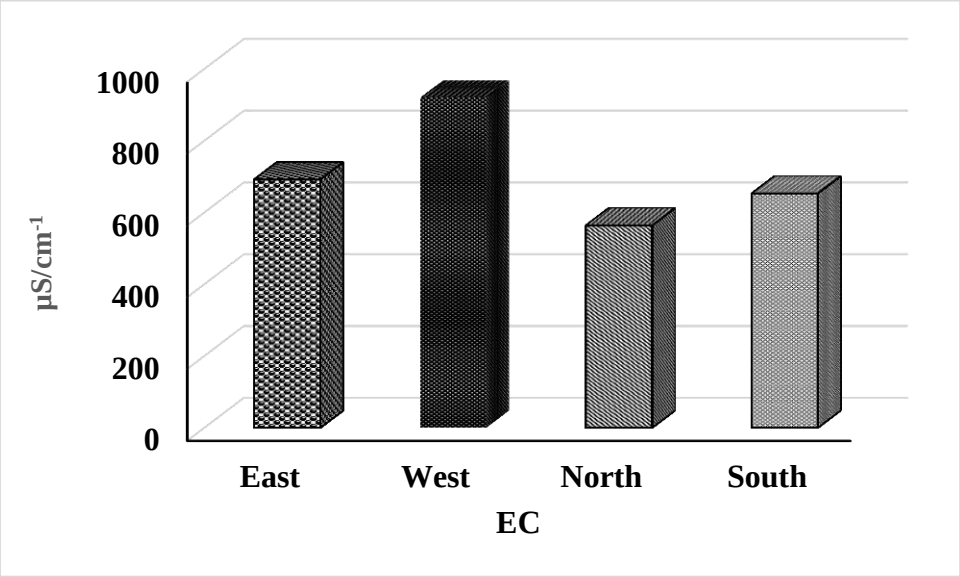

Figure 3 Variation of the Electrical conductance of water samples at different locations

Total Solids: Solid refers to suspended and dissolved matter in water. They are very useful parameters describing the chemical constituents of the water and can be considered as general of edaphically relation that contributes to productivity within the water body (Goher, 2002).The recorded TS value was more or less similar in all sample points as well as four sites. South 1460mg/l, east 1488 mg/l, north 1504and west 1580 mg/l, respectively.

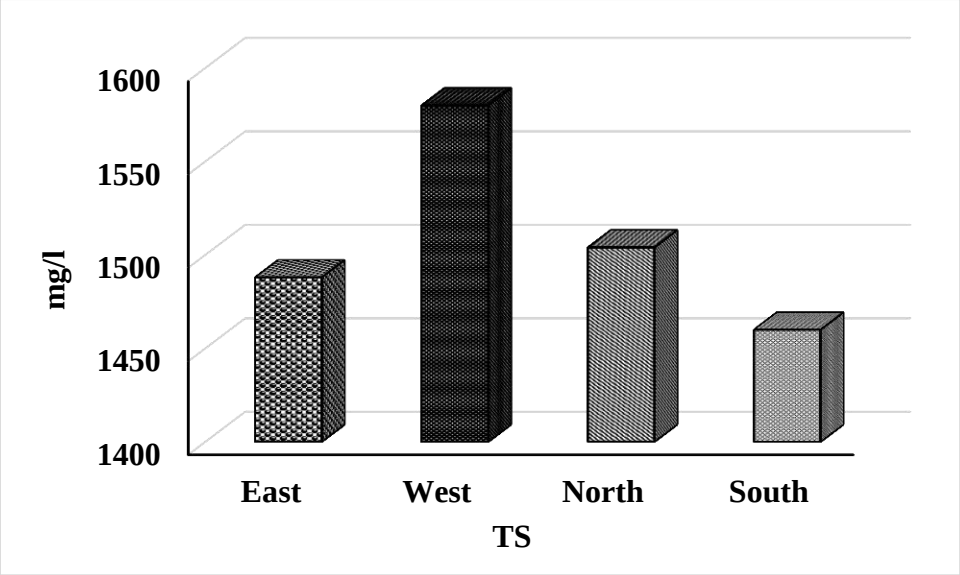

Figure 4 Variation of the total solids of water samples at different locations

Total Dissolved Solids (TDS): Total dissolved solids describes the amount of inorganic salts of calcium, magnesium, sodium etc. and small proportion of organic matter present in the water, where a high value of the same have been reported to be related to acute myocardial infarction as well as ischemic heart diseases in few studies (Sneka Lata, *et al*., 2015). In this study, TDS values showed a considerable variability ranging from < 10 ppm - >1500 ppm. The maximum value of TDS was at south at i.e. 1006and minimum at site east i.e. 900 mg/l. During the study zone North and south relative amount of solutes were high due to decrease in the water level in the river (Bhattaraj *et al*. 2008). But slightly vary about north 1004 and west 905 mg/l.

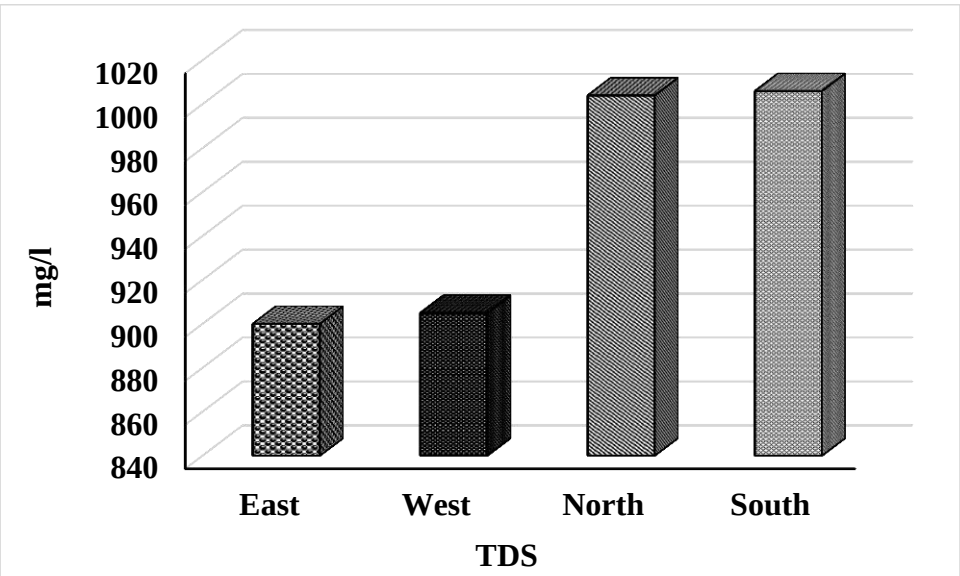

Figure 5 Variation of the total dissolved solids of water samples at different locations

Total Suspended Solids (TSS): Total suspended solid content of water depends on the amount of suspended particle, soil and siltwhich is directly related to turbidity of water.

The present study shows that the average value ofTSS varies from 167.78 to 278.33 mg/l**.** The present investigation, TSS value of east 632 mg/l, west690mg/l), north (450mg/l) and south (632 mg/l). The maximum value was at west and minimum at north.

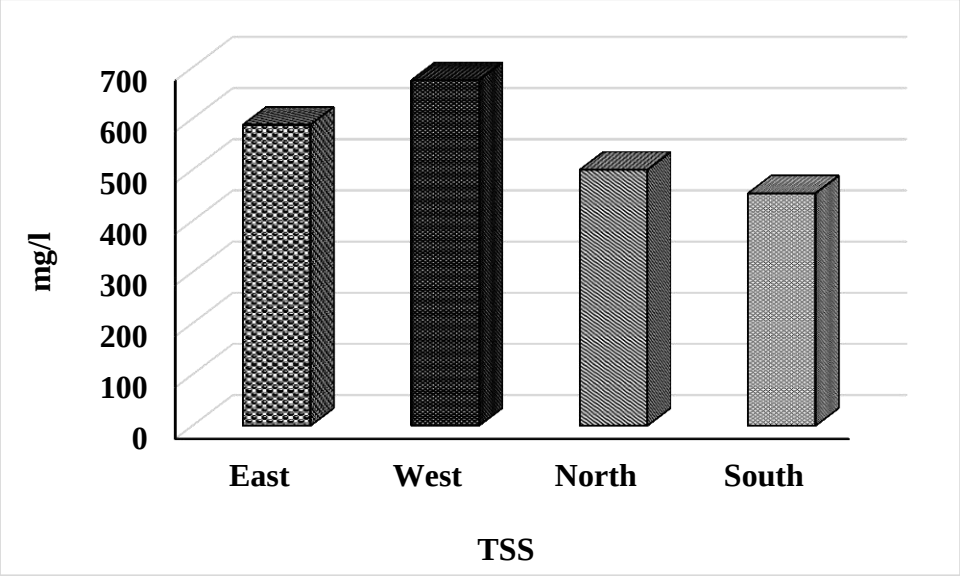

Figure 6 Variation of the total suspended solids of water samples at different locations

Hardness: Hardness of water is an important consideration in determining the suitability of water fordomestic and industrial uses. Hardness is caused by multivalent metallic cations and withcertain anions present in the water to form scale. The principal hardness-causing cations arethe divalent calcium, magnesium, strontium, ferrous iron and mangnous ions. Total hardness was recorded at east site (220mg/l), west site (340mg/l), north site (160mg/l) and south site (140mg/l). Hardness was below the permissible limit in all samples and might have caused increased concentration of salts by excessive evaporation as also observed by Bhatt *et al*. (1999).

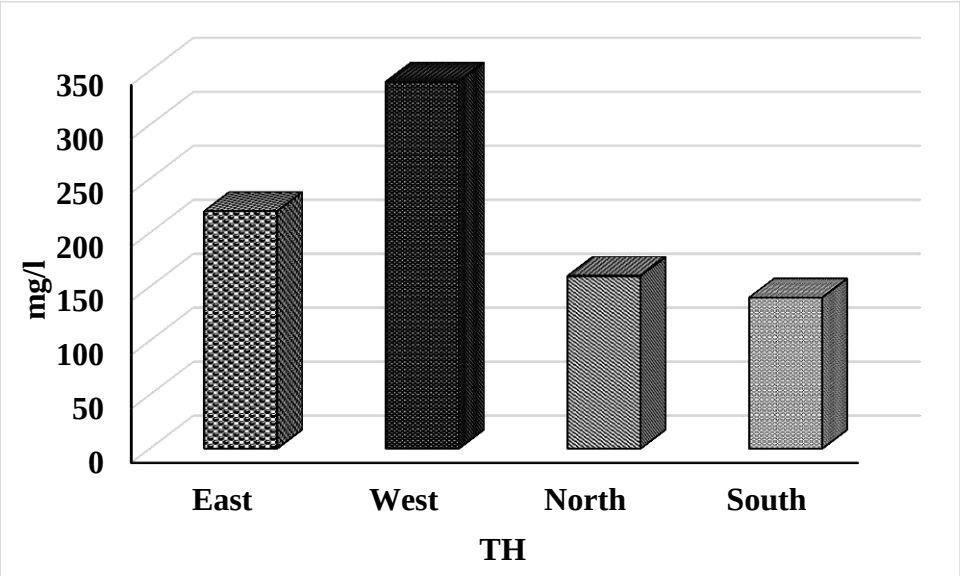

Figure 7 Variation of the Hardness of water samples at different locations

Chlorides: It occurs naturally in all types of waters. High concentration of chlorides is considered to be the indicators of pollution due to organic wastes of animal or industrial origin. Chlorides are troublesome in irrigation water and also harmful to aquatic life (Rajkumar, 2004). The chloride content showed very narrow changes in sampling points between four sites. The recorded values of east site 260 mg/l, west 380 mg/l, north 220and south 159 mg/l. Higher concentration of chloride is hazardous to human consumption and creates health problems. Desirable limit of chloride by ISI (1991) for drinking purpose is 250 mg/l.

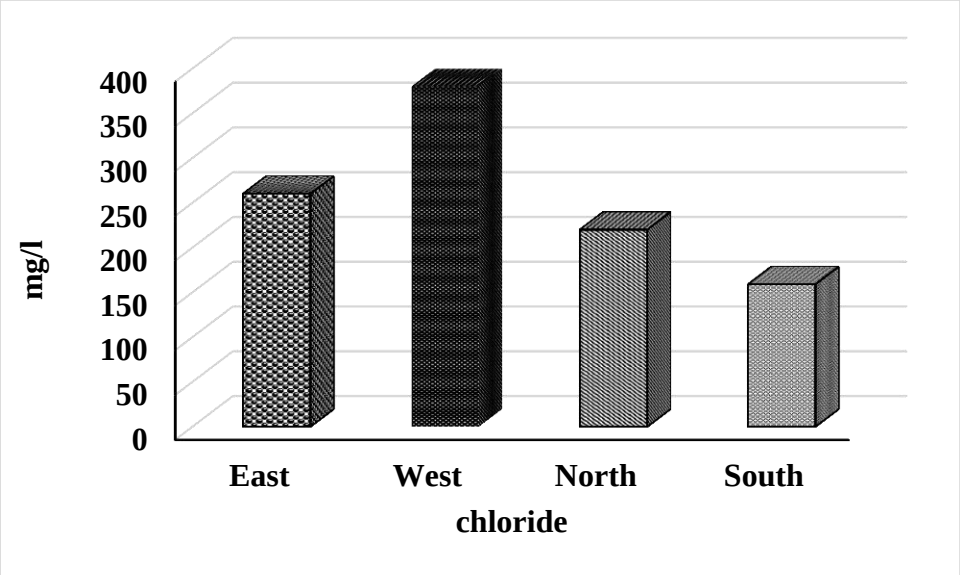

Figure 8 Variation of the Chloride of water samples at different locations

Dissolved oxygen (DO): The dissolved oxygen content is one of the most important factors in stream health. Its deficiency directly affects the ecosystem of a river due to bioaccumulation and biomagnifications. The oxygen content in water samples depends on a number of physical, chemical, biological and microbiological processes. DO values also show lateral, spatial and seasonal changes depending on industrial, human and thermal activity. In the present study, the value of DO ranged from 5.04 mg/l in east followed by, 5.42 mg/l in north, 5.45 in south and 5.59 mg/l in west, respectively. The similar results were also found by Bhattaraj *et al. (*2008).

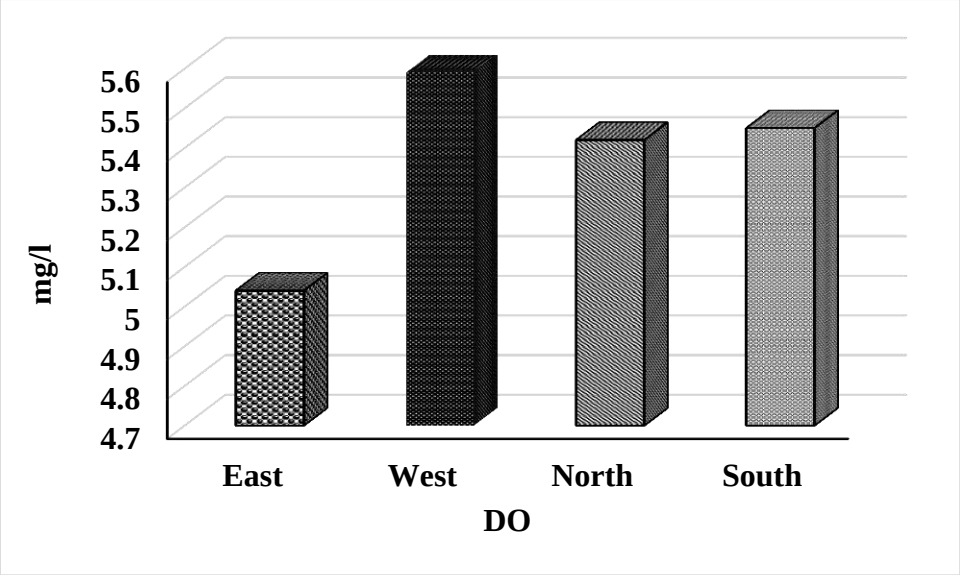

Figure 9 Variation of the DO of water samples at different locations

Biological Oxygen Demand (BOD): is a measure of the oxygen in the water that is required by the aerobic organisms. The biodegradation of organic materials exerts oxygen tension in the water and increases the biochemical oxygen demand (Abida, 2008). BOD_5 is the amount of oxygen required by the living organisms engaged in the utilization and ultimate destruction or stabilization of organic water (Hawkes 1993). The value for BOD was found to be maximum 38 mg/l in west followed by, east 35 mg/l. Both north and south recorded as 25 mg/l shown in figure 10.

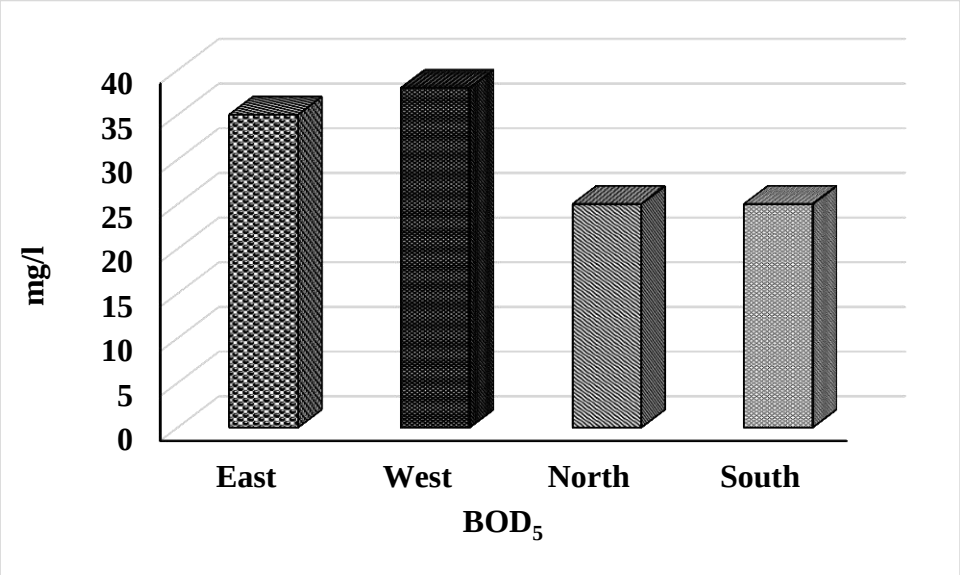

Figure 10 Variation of the BOD_5 of water samples at different locations

Chemical Oxygen Demand (COD): is a measure of the oxidation of reduced chemicals in water. It is commonly used to indirectly measure the amount of organic compounds in water. The measure of COD determines the quantities of organic matter found in water. This makes COD useful as an indicator of organic pollution in surface water (King *et al.*, 2003 and Faith, 2006). The chemical oxygen demand (COD) marked difference

among varies site. The highest COD range observed in west 304mg/l followed by, east 250 mg/l, south 155 mg/l and north 136 mg/l, figure 11 respectively.

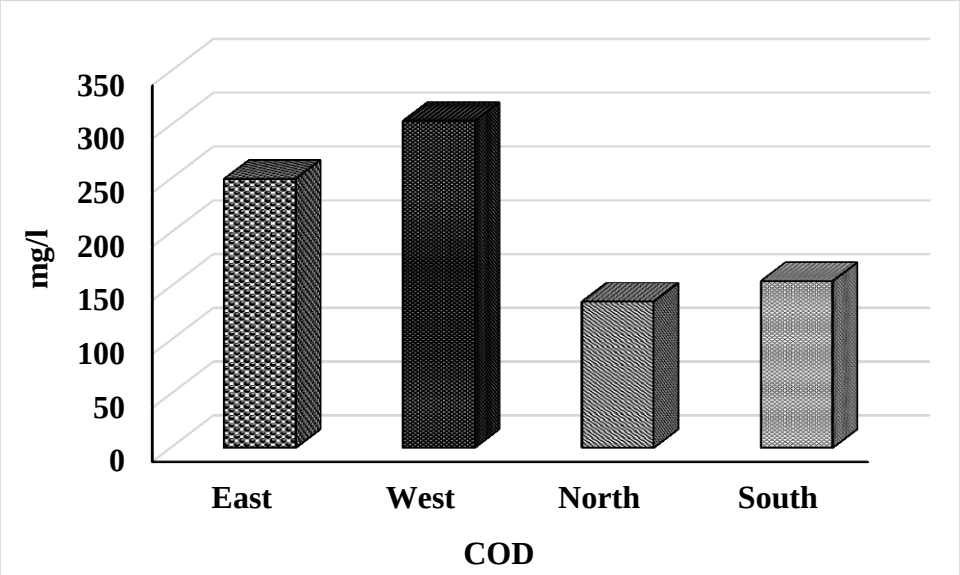

Figure 11 Variation of the COD of water samples at different locations

Phosphate: Phosphate is rarely found in high concentrations in waters as it is actively taken up by plants. High concentrations of phosphates can indicate the presence of pollution and are largely responsible for eutrophic conditions (WHO, 1993). The anthropogenic additions of phosphorus to the river have a considerable effect on the quality of the water. Such phosphate is derived mainly from domestic sewage and the runoff from agricultural areas. The phosphate content found maximum in west 6 mg/l followed by, north 5.42mg/l, south 5.45mg/land east 5.04 mg/l shown in figure 12 respectively.

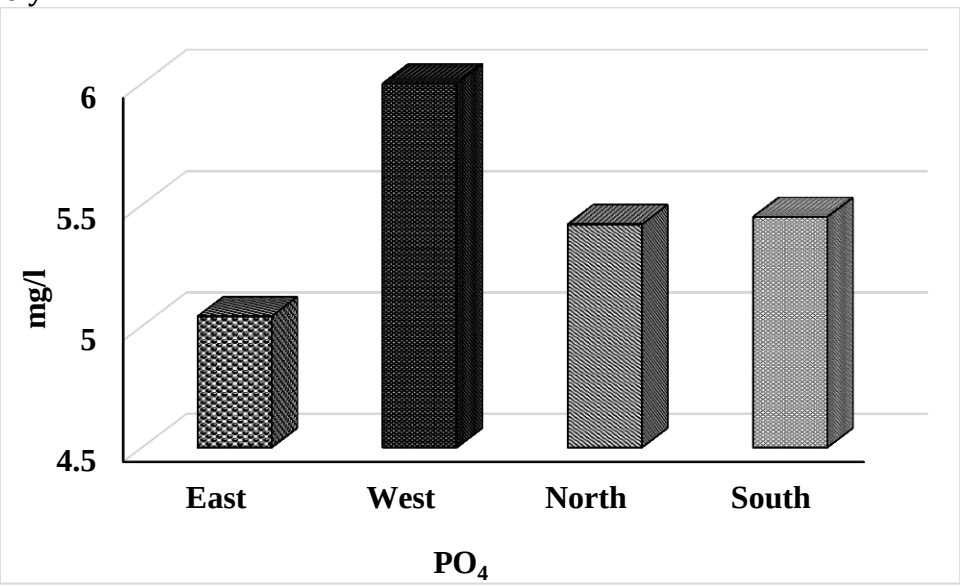

Figure 12 Variation of the PO_4 of water samples at different locations

Sulphate: It is a substance that occurs naturally in drinking water. Health concerns regarding sulphate in drinking water have been raised because of reports that diarrhea may be associated with the ingestion of water containing high levels of sulfate. Sulphate

gives a bitter or medicinal taste to water if it exceeds a concentration of 250 mg/l. This may make it unpleasant to drink the water. The sulphate content of natural waters is an important consideration in determining their suitability for public and industrial supplies. SO_4 was recorded as east 58 mg/l, west 60 mg/l, north 27 mg/land south 35mg/l as shown in figure 13. High concentration of sulphate could cause respiratory problems in human beings (Sujitha *et al*., 2011).

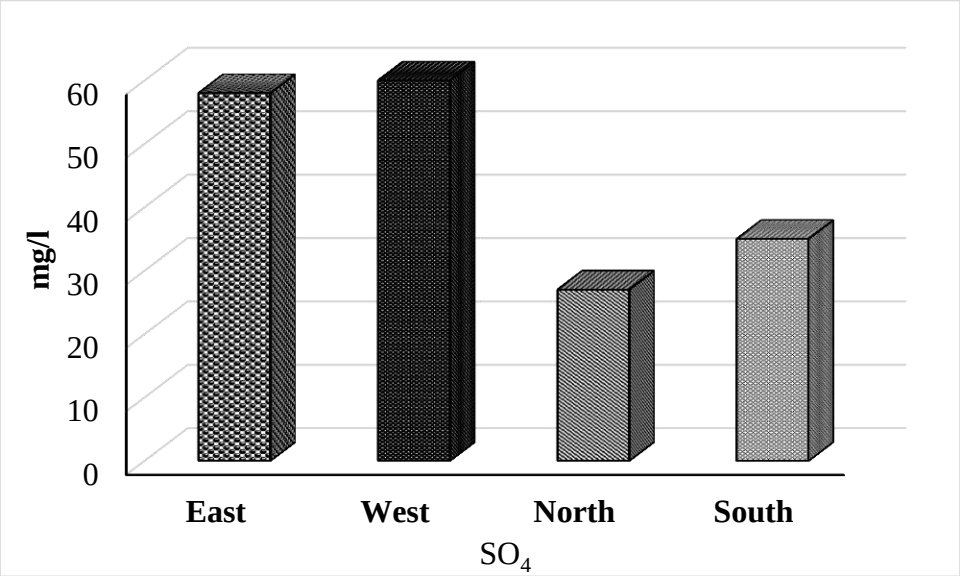

Figure 13 Variation of the SO_4 of water samples at different locations

Table 1 Physico-chemical parameters of four sampling site

S.No	Parameters	East (Mean ±SD)	West (Mean± SD)	North (Mean ±SD)	South (Mean ± SD)	WHO Standard (1993)
1	TemperatureºC	27.5 ± 0.1	26 ± 0.13	26 ± 0.13	25 ± 0.25	-
2	pH	7.85 ±0.09	7.86 ± 0.09	7.63 ± 0.14	7.63 ± 0.13	6.5 to 8.5
3	EC (µS/cm^{-1})	692 ±46.5	920 ±29.56	564 ±12.08	653 ± 15.62	-
4	TS (mg/l)	1488 ±238.39	1580 ±69.6	1504 ±104.34	1460 ±71.39	-
5	TDS (mg/l)	900 ±232.9	905 ±246.35	1004 ±268	1006 ±219	1000
6	TSS (mg/l)	632 ±131.87	690 ±86.85	450±68.57	632.98 ±69.1	-
7	TH (mg/l)	220 ±22.22	340 ±31.83	160±9.67	140 ±17.79	500
8	Chloride (mg/l)	260 ±58.25	380 ±30.64	220 ±22.67	159 ±9.38	250
9	DO (mg/l)	5.04 ±0.51	5.59 ±0.32	5.42 ±0.29	5.45 ±0.27	-
10	COD (mg/l)	250 ±39.06	304 ±63.26	136 ±17.34	155 ±11.42	250
11	BOD_5 (mg/l)	35 ±1.9	38 ±4.23	25 ±3.04	25 ±3.04	-
12	PO_4 (mg/l)	5.04 ±0.51	6 ±0.32	5.42±0.29	5.45 ±0.27	0.1
13	SO_4 (mg/l)	58 ±3.85	60 ±4.1	27±1.06	35 ±2.05	-

Table 2. Correlation coefficients between the physico-chemical parameters in the Erode region of river Cauvery.

Parameters	Temp	pH	EC	TS	TDS	TSS	TH	Cl	DO	COD	BOD_5	PO_4	SO_4
Temp	1.000												
pH	0.602	1.000											
EC	0.935	0.770	1.000										
TS	0.935	0.607	0.805	1.000									
TDS	-0.548	-0.997	-0.73	-.564	1.000								
TSS	0.822	0.922	0.862	0.866	-0.901	1.000							
TH	0.925	0.850	0.939	0.917	-0.815	0.975	1.000						
Cl	0.895	0.824	0.866	0.950	-0.792	0.978	0.983	1.000					
DO	0.609	-0.264	0.376	0.507	0.327	0.067	0.269	0.249	1.000				
COD	0.778	0.963	0.912	0.727	-0.944	0.953	0.939	0.891	-0.011	1.000			
BOD_5	0.715	0.988	0.85	0.707	-0.976	0.962	0.918	0.889	-0.116	0.990	1.000		
PO_4	0.881	0.155	0.709	0.787	-0.089	0.467	0.640	0.613	0.911	0.396	0.302	1.000	
SO_4	0.605	0.980	0.814	0.539	-0.973	0.872	0.825	0.764	-0.230	0.968	0.971	0.176	1.000

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